(1) Find $\frac{d}{dx}\left(\pm\sqrt{\frac{8-x^4}{2}}\right)$

(2) Give the chain rule formula

(3) What does $\frac{dy}{dx}$ mean? Be as thorough as possible.

$\pm\sqrt{\frac{8-x^4}{2}}$ $\pm\sqrt{4-\frac{1}{2}x^4}$ $y=\pm\sqrt{u}$ $u=4-\frac{1}{2}x^4$

$\frac{dy}{du}=\frac{1}{2\sqrt{u}}$ $\frac{du}{dx}=-2x^3$ $\frac{dy}{dx}=\pm\frac{2x^3}{2\sqrt{4-\frac{1}{2}x^4}}\pm\frac{x^3}{\sqrt{4-\frac{1}{2}x^4}}$

$x^4+2y^2=8$

$\frac{dy}{dx}=\frac{dy}{du}\cdot\frac{du}{dx}$

↓

Change in y in relation to change in x

derivative of y with respect to x

instantaneous rate of change

Implicit Differentiation

- easier in some cases
- allows to find more derivatives

Explicit

$y^2 = x$

$y = \pm\sqrt{x}$

$\frac{dy}{dx} = \pm\frac{1}{2\sqrt{x}}$

Implicit

$y^2 = x$

$2y\frac{dy}{dx} = 1$

$\frac{dy}{dx} = \frac{1}{2y}$

$x^4 + 2y^2 = 8$

$4x^3\frac{dx}{dx}$

$4x^3 + 4y^1 \cdot \frac{dy}{dx} = 0$

$\frac{dy}{dx} = -\frac{4x^3}{4y} = -\frac{x^3}{y}$

$$2y = x^2 + \sin y$$

$$2\frac{dy}{dx} = 2x + \cos(y)\frac{dy}{dx}$$

$$-\cos(y)\frac{dy}{dx}$$

$$2\frac{dy}{dx} - \cos(y)\frac{dy}{dx} = 2x$$

$$\frac{dy}{dx}\left(2 - \cos(y)\right) = 2x$$

$$\frac{dy}{dx} = \frac{2x}{2 - \cos y}$$

Try

$$x^2 - xy + y^2 = 7$$

$$2x - \left(x\frac{dy}{dx} + y(1)\right) + 2y\frac{dy}{dx} = 0$$

$$2x - x\frac{dy}{dx} - y + 2y\frac{dy}{dx} = 0$$

$$-x\frac{dy}{dx} + 2y\frac{dy}{dx} = -2x + y$$

$$\frac{dy}{dx}\left(-x + 2y\right) = -2x + y$$

$$\frac{dy}{dx} = \frac{-2x + y}{-x + 2y}$$

$x^2 + y^2 = 25$, find slope at the point $(3, -4)$

$$2x + 2y\frac{dy}{dx} = 0$$

$$\frac{dy}{dx} = \frac{-2x}{2y}$$

$$\frac{dy}{dx} = -\frac{x}{y}\Big|_{(3,-4)} = -\frac{3}{-4} = \boxed{\frac{3}{4}}$$

$\frac{d^2y}{dx^2}$ of $2x^3 - 3y^2 = 8$

$6x^2 - 6y\frac{dy}{dx} = 0$

$6\left(x^2 - y\frac{dy}{dx}\right) = 0$

$x^2 - y\frac{dy}{dx} = 0$

$\frac{dy}{dx} = \frac{-x^2}{-y} = \frac{x^2}{y}$

$\frac{d^2y}{dx^2} = \frac{y(2x) - x^2\frac{dy}{dx}}{y^2} = \frac{2xy - \frac{x^4}{y}}{y^2}$

Sect. 3.7

#1, 4, 5, 6, 7, 10, 11, 13, 16, ~~18, 19, 22, 23, 25, 29, 30~~